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PARASITES AND PREDATORS OF THE MEXICAN BEAN BEETLE IN THE UNITED STATES

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INTRODUCTION

The Mexican bean beetle (*Epilachna varivestis* Muls.)[1] has been practically unimpeded by parasites or predators in its spread through the intensively cultivated areas of the United States. Gradually, however, a considerable list of natural enemies has been accumulated through its longer establishment in certain areas and more careful observation by entomologists, and these natural enemies are here briefly discussed.

LISTS OF PARASITES AND PREDATORS OF THE MEXICAN BEAN BEETLE

The natural enemies of the Mexican bean beetle referred to in published and unpublished records may be divided into three classes: (1) Parasites and predators actually observed attacking the bean beetle in the field; (2) predators feeding on the beetle in confinement; and (3) parasites and predators attacking the bean beetle in Mexico and occurring in certain parts of the United States where they may be considered as potential enemies.

These natural enemies, classified as above, are shown in tables 1 to 3, respectively, which also show the localities where they were observed and the stages of the bean beetle attacked, and, in the last column, the source of the information, the letter X indicating unpublished observations by the authors or others mentioned in the text and the italic numbers in parentheses referring to the list of literature cited on page 12.

[1] Formerly known as *Epilachna corrupta* Muls.

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TABLE 1.—*Parasites and predators actually observed attacking the Mexican bean beetle in the field*

PARASITES

Natural enemies	Localities	Stages attacked [1]	Reference
Alysiidae:			
Synaldis sp			X.
Tachinidae:			
Doryphorophaga doryphorae Riley	Ohio	d	X.
Nemorilla maculosa Meig	New Mexico	b	(*4.*) [2]
Paradexodes epilachnae Ald	Mexico	b, c	X.
Phorocera claripennis Macq	Ohio, Alabama, Kentucky, Maryland, Tennessee, Virginia, New Jersey, North Carolina.	b, c	(*11, 12, 13.*)
Unknown species	Colorado	d	(*3.*)
Do	New Mexico	d	X.
Do	Ohio	d	X.
Sarcophagidae:			
Helicobia helicis Towns	Alabama	b	(*11, 12.*)
Sarcophaga latisterna Park	Ohio	d	X.
Phoridae:			
Megaselia sp	Ohio, Virginia, Alabama	b, c	X.
Bacteria:			
Coccobacillus sp	Alabama	b, c	(*12.*)
Streptococcus sp	do	b, c	(*12.*)
Unknown	South Carolina	b	(*6.*)
Fungi imperfecti:			
Beauveria globulifera	New Mexico, Virginia	d	(*5.*)
Cephalothecium sp	Georgia	a	X.
Cordyceps militaris (L.) Link	New Mexico, Ohio	d	X.
Isaria sp	New Mexico, Virginia	d	X.

PREDATORS

Aves:			
Guinea fowl	Alabama	d	X.
Pheasant	Pennsylvania	d	X.
Quail	do	d	X.
Turkey	New Mexico	d	(*4.*)
Mammalia:			
Skunk	Ohio	d	X.
Arachnida:			
Allothrombium sp	Virginia		X.
Chilopoda:			
Centipede	Ohio	d	X.
Formicidae:			
Pheidole sp	Alabama	c	(*10, 12.*)
Solenopsis geminata Fab	do	c	(*10, 12.*)
Ant	Arizona	a	(*14.*)
Do	Kentucky	b, c	X.
Noctuidae:			
Heliothis obsoleta Fab	Alabama, Ohio	b, c	(*10, 12.*)
Laphygma frugiperda S. and A	Alabama	b, c	(*8, 10, 12.*)
Prodenia ornithogalli Guen	do	b, c	(*8, 10, 12.*)
Coccinellidae:			
Ceratomegilla fuscilabris Muls	Ohio, Alabama, South Carolina	a, b	(*6, 8, 9, 11, 12, 18.*)
Chilocorus bivulnerus Muls	Alabama	a	X.
Coccinella novemnotata Hbst	do	a, b	(*8, 9, 12.*)
Epilachna varivestis Muls	Alabama, Ohio, etc	a, b, c	(12.)
Hippodamia convergens Guer	Alabama, Ohio, New Mexico, South Carolina.	a, b	(*2, 3, 7, 8, 9 12, 14.*)
Melyridae:			
Collops bipunctatus Say	New Mexico	a	(*4.*)
Carabidae:			
Ground beetle	do	d	(*4.*)
Anthocoridae:			
Orius insidiosus Say	Ohio	c	(*13.*)
Nabidae:			
Nabis ferus L	do	a, b	X.
Nabis roseipennis Reut	do	a, b	X.
Reduviidae:			
Sinea diadema Fab	Alabama, Ohio	b, c	(*10.*)
Pentatomidae:			
Acrosternum hilaris Say	Connecticut, Alabama	a, b, c	(*8.*)
Nezara viridula L	Ohio	a	(*15.*)
Perillus bioculatus Fab	Ohio, Mexico	b, c	(*16.*)

[1] a=Eggs of the Mexican bean beetle; b=larvae; c=pupae; and d=adults.
[2] Italic figures in parentheses refer to Literature Cited, p. 12.

TABLE 1.—*Parasites and predators actually observed attacking the Mexican bean beetle in the field*—Continued

PREDATORS—Continued

Natural enemies	Localities	Stages attacked	Reference
Pentatomidae—Continued.			
Podisus maculiventris Say	Ohio, Pennsylvania, Virginia, Connecticut, South Carolina.	a, b, c, d	(*1, 7, 8, 9, 11, 12, 13.*)
Stiretrus anchorago Fab	Ohio, Alabama, Mexico	a, b, c, d	(*1, 8, 9, 11, 12, 16, 18.*)
Chrysopidae:			
Chrysopa sp		b	(*3.*)

TABLE 2.—*Predators feeding on the Mexican bean beetle in cages*

Natural enemies	Localities	Stages attacked [1]	Reference
Amphibia:			
Garden toad	Alabama	d	X.
Coccinellidae:			
Adalia bipunctata L	do	a, b	(*8, 9, 12.*)
Anatis 15-punctata Oliv	do	a	X.
Coccinella transverscguttata Fab		a	(*2, 3.*)
Cycloneda sanguinea L	Alabama	a	(*8, 9, 12.*)
Hippodamia ambigua Lec	(Alabama, introduced)	a, b	(*9.*)
Hippodamia 5-signata Kby		a	(*2, 3.*)
Carabidae:			
Calosoma sayi Dej	Alabama	b, c, d	(*8, 9, 12.*)
Harpalus caliginosus Fab	do	b, c, d	(*9, 12.*)
Harpalus pennsylvanicus Dej	Ohio	b	(*15.*)
Scarites subterraneus Fab	Alabama	b, c, d	(*8, 9, 12.*)
Cicindelidae:			
Tetracha carolina L	do	a, b, c, d	(*9, 12.*)
Tetracha virginica L	do	a, b, c, d	(*9, 12.*)
Reduviidae:			
Arilus cristatus L	Alabama, Ohio	b, c, d	(*8, 9, 12, 17.*)
Pentatomidae:			
Perillus circumcinctus Stål	Ohio	d	(*17.*)
Chrysopidae:			
Chrysopa oculata Say	Alabama	c	(*8, 12.*)
Chrysopa rufilabris Burm	do	c	(*8, 12.*)

[1] a=Eggs of the Mexican bean beetle; b=larvae; c=pupae; d=adults.

TABLE 3.—*Parasites and predators of the Mexican bean beetle in Mexico which are also indigenous to the United States*

PARASITES

Natural enemies	Localities	Stages attacked [1]	Reference
Tachinidae:			
Hyalomyodes triangulifera Loew	New York	b	X.
Sarcophagidae:			
Sarcophaga rheinhardi Hall	Texas, Utah	b	X.

PREDATORS

Reduviidae:			
Apiomerus pictipes H. S	Colorado, New York	b	(*16.*)
Pselliopus zebra Stål	Arizona	b	(*16.*)
Pentatomidae:			
Euthyrhynchus floridanus L	Pennsylvania, Georgia, North Carolina, Tennessee.	b	(*16.*)
Oplomus dichrous H. S	Arizona	b	(*16.*)
Perillus confluens H. S	Colorado, Texas, New Mexico	b	(*16.*)
Piezodorus guildinii Westw	Georgia, New Mexico	b	(*16.*)
Podisus lineolatus H. S	Texas	b, c	(*16.*)
Podisus sagitta Fab	do	b, c	(*16.*)

[1] a=Eggs of the Mexican bean beetle; b=larvae; c=pupae; d=adults.

HYMENOPTERA

Synaldis sp., of the hymenopterous family Alysiidae, is recorded in the files of the late F. H. Chittenden as having been reared from *Epilachna corrupta* (= *E. varivestis*).

The ants *Solenopsis geminata* and *Pheidole* sp. destroyed bean beetle pupae in cages both in the field and in the insectary at Birmingham, Ala., in 1921 (*10*, *12*). Merrill (*14*) states that "Dr. Morrill, of Arizona, reports 'an ant observed eating the eggs on one occasion'." The junior author observed numbers of a small black ant feeding on mature larvae and pupae of the bean beetle at Louisville, Ky., in 1932.

DIPTERA

Phorocera claripennis, a tachinid parasite of Lepidoptera (fig. 1, *A*), is the only native parasite of wide distribution which attacks the bean beetle. It was reared from bean beetle larvae first in 1922 in northern Alabama (*11*), and since then has been reared from larvae collected in Ohio, Kentucky, Tennessee, Virginia, Maryland, New Jersey, and North Carolina.

In Ohio it has been found that the first collections that can be made of mature fourth-instar bean beetle larvae each season contain approximately 3 percent of parasitized larvae. The percentage of parasitization gradually decreases during the summer, although there is a trace of parasitization until the end of the season. In 1935 a collection of 600 larvae made July 8 contained 1.5 percent of parasitized larvae, and 3,000 larvae collected August 27 contained 1.3 percent of parasitized larvae.

At Birmingham, Ala., *Phorocera claripennis* was collected in bean beetle larvae from June 2 through September 1 in 1922. Here, as elsewhere, it was observed that the parasitization was higher among larvae feeding on soybeans in blossom than among larvae feeding on garden beans.

Phorocera claripennis deposits from one to three or four small, white, elliptical, flattened, macrotype eggs on larval, pupal, or adult bean beetles (fig 1, *B*). Areas around the wounds in the hosts, made by maggots on entering, sink and become black. Two days before the maggot leaves the host the latter appears lifeless and is of a muddy yellow color. Much of the host is left unabsorbed as the mature maggot cuts an irregularly shaped hole and leaves the host to enter the soil. The mature third-instar maggot is stout and subcylindrical, and with the caudal end flattened in a dorsally oblique plane. The two chitinous anal stigmatal plates are dark and conspicuous. Only one maggot develops in a bean beetle larva. Maggots from eggs laid on adult beetles fail to mature. J. R. Douglass found the incubation period at Birmingham, Ala., to last from 1 to 3 days, the average for 37 eggs being 1.8 days. The average length of the developmental period for 14 maggots was 7.4 days. Pupation usually occurs in the soil, although it has been observed occasionally in the host shell. The puparia are dull, yellowish red, and between 4 and 5 mm in length. The average length of the developmental period for 11 puparia was 9.6 days.

A tachinid, *Nemorilla maculosa*, has been reared from bean beetle larvae collected near Albuquerque, N. Mex. (*4*). In correspondence

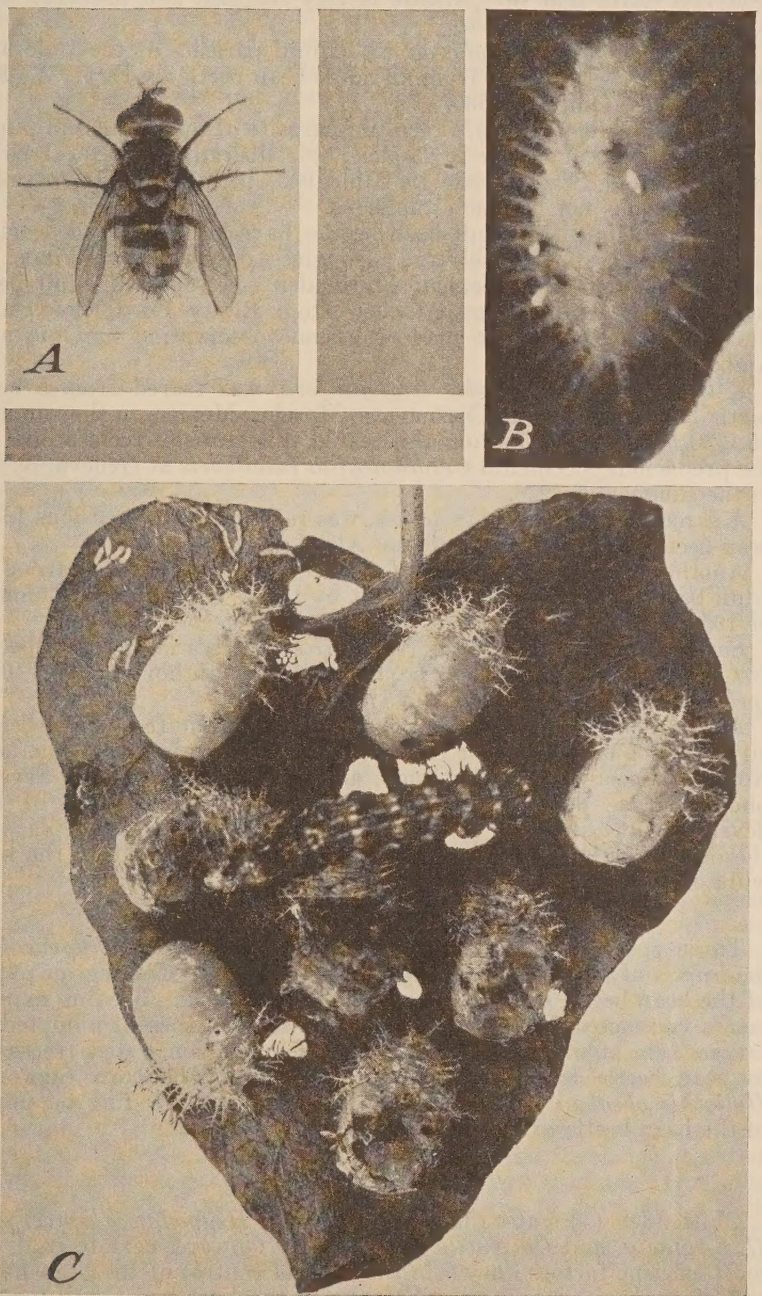

FIGURE 1.—Enemies of the Mexican bean beetle: *A*, *Phorocera claripennis*, a native parasite of the larger larvae, × 2½; *B*, eggs of *P. claripennis* on fourth-instar larva, × 6; *C*, corn earworm feeding on pupa of the Mexican bean beetle, × 4.

Douglass states that the parasite is very sluggish and probably will not be of much importance.

Doryphorophaga doryphorae, a tachinid parasite of the Colorado potato beetle, was reared from an adult bean beetle by H. G. Walker at Columbus, Ohio, in 1930.

Paradexodes epilachnae, a tachinid parasite of the larval and pupal stages of the bean beetle in Mexico, was liberated in several parts of the United States from 1931 to 1935, inclusive. The parasite apparently has not become established.

In several localities adult bean beetles have been observed bearing tachinid eggs on their elytra. Douglass observed two kinds of tachinid eggs in New Mexico; Chittenden (*3*) reported adult bean beetles with tachinid eggs attached from Rocky Ford, Colo., and the present authors have made the same observation in Ohio and Alabama.

A tachinid, *Hyalomyodes triangulifera*, was reared from a bean beetle larva collected at Cuernavaca, Morelos, Mexico, in the summer of 1930. The junior author also reared this parasite from adults of the predacious coccinellid *Ceratomegilla fuscilabris* at Geneva, N. Y., in the summer of 1928.

A sarcophagid, *Helicobia helicis*, was reared on two occasions from bean beetle larvae at Birmingham, Ala. (*11*, *12*).

Another sarcophagid, *Sarcophaga latisterna*, was reared from an adult bean beetle at Columbus, Ohio, by H. G. Walker in the summer of 1930.

Sarcophaga rheinhardi was reared from a larva of the bean beetle at Cuernavaca, Morelos, Mexico, by the junior author in 1930. This species also occurs in Texas and Utah.

A small phorid, *Megaselia* sp., has been reared from bean beetle larvae and pupae collected from the field at Birmingham, Ala., and Norfolk, Va., by L. W. Brannon, and at Columbus, Ohio. Several phorid larvae develop in a single host. Although most of the developmental stage of the fly has been observed to take place in the dead host it is believed that the eggs are deposited on the host while still alive.

LEPIDOPTERA

Three species of Noctuidae, *Heliothis obsoleta*, *Laphygma frugiperda*, and *Prodenia ornithogalli*, were observed feeding on pupae of the bean beetle in the field at Birmingham, Ala. Feeding experiments conducted in the insectary showed that these lepidopterous larvae were able to complete their development on a diet restricted to bean beetle larvae and pupae (*10*, *12*). The corn earworm, *Heliothis obsoleta* (fig. 1, *C*), has been observed feeding on pupae of the bean beetle in Ohio also.

COLEOPTERA

Chittenden (*3*) states that the coccinellids *Hippodamia convergens*, *H. 5-signata*, and *Coccinella transversoguttata* are, next to cold, the most efficient factors known in the natural control of the bean beetle in Colorado and neighboring States. In the East and South *Ceratomegilla fuscilabris* (*Megilla maculata*) is the most voracious and usually the most numerous coccinellid feeding on the bean beetle. Of 200

egg masses of the bean beetle collected at Birmingham, Ala., July 28, 1921, 19, or 9.5 percent, showed injury ranging from 3.7 to 93 percent caused presumably by *C. fuscilabris*.[2] The effectiveness of *C. fuscilabris*, however, is not a constant factor because of the variable abundance of the species from year to year (*7*, *12*).

Larvae and adults of Coccinellidae prey chiefly on the eggs and young larvae of the bean beetle. The relative values of the more prevalent species, as determined by feeding experiments conducted in the insectary at Birmingham, are shown in table 4.

TABLE 4.—*More important coccinellids (in adult stage) recorded as feeding on the Mexican bean beetle at Birmingham, Ala.*

Species	Average host stages eaten per day		
	Eggs	First instar	Second instar
	Number	*Number*	*Number*
Ceratomegilla fuscilabris	12.13	7.28	3.64
Hippodamia convergens	3.50	----------	----------
Coccinella novemnotata	1.99	1.19	----------
Adalia bipunctata	1.23	.74	----------
Cycloneda sanguinea	.82	----------	----------

Anatis 15-punctata fed slightly on eggs of the bean beetle in the insectary, and *Chilocorus bivulnerus* was observed feeding on eggs in the field at Birmingham. *Hippodamia ambigua*, received from California for tests with the bean beetle, fed slightly on eggs in the insectary.

Adults of *Epilachna varivestis* feed on their own eggs in the field when ample bean foliage is present (*12*). In the absence of green foliage adults and larvae feed very commonly on eggs, very young larvae, and occasionally on pupae of *E. varivestis*.

A melyrid beetle, *Collops bipunctatus*, was observed feeding on eggs of the bean beetle in the field, and laboratory tests at Estancia, N. Mex., confirmed the field observations (*4*).

The value of carabids in the control of the bean beetle is problematical. As most species are nocturnal, much of their feeding passes unnoticed. Adult carabids kept in cages containing soil dug burrows into which host stages were carried before they were consumed. Elytra and chitinized parts of bean beetles are often found under debris both in bean fields and in winter hibernation quarters. Douglass (*4*) reports, "During July 1930, 122 beetles were found stuck in the mud. Some of these are preyed on by ground beetles (Carabidae) * * *."

Adults of two species, *Calosoma sayi* and *Harpalus caliginosus*, and larvae of *Scarites subterraneus* were collected from bean fields and confined with stages of the bean beetle at Birmingham. One adult *C. sayi* lived 38 days, an adult *H. caliginosus* 43 days, and a larva of *S. subterraneus* 32 days. None of these species fed to any appreciable extent in confinement, although *H. caliginosus* was observed

[2] The authors are grateful to H. L. Weatherby, J. R. Douglass, and L. W. Brannon for recording many of the notes on feeding habits of predacious insects at Birmingham, Ala.

in the field feeding on a bean beetle larva. Adults of *H. pennsylvanicus* were taken by Miller (*15*) in Ohio feeding on young larvae on the ground and on plants.

The average number of hosts consumed per day by those species found at Birmingham as compared with *Calosoma laeve* Chev., a carabid which feeds on the bean beetle at Mexico City (*16*), is given in table 5.

TABLE 5.—*Food consumed daily by species of carabids in confinement at Birmingham, Ala., compared with the daily feeding of Calosoma laeve at Mexico City, Mexico*

Species	Stage of carabid	Average hosts eaten per day					
		First instar	Second instar	Third instar	Fourth instar	Pupae	Adults
		Number	*Number*	*Number*	*Number*	*Number*	*Number*
Scarites subterraneus	Larva	14.81	7.41	3.70	0.74	0.93	1.24
Calosoma sayi	Adult	16.24	8.12	4.06	.81	1.02	1.35
Harpalus caliginosus	do	2.51	1.26	.63	.13	.16	.21
Calosoma laeve	do	58.24	29.12	14.56	2.91	3.64	4.85

Two tiger beetles, *Tetracha carolina* and *T. virginica*, in both larval and adult stages consumed large numbers of larvae, pupae, and adults of the bean beetle in confinement at Birmingham. Eggs were not consumed when other food was present. It is questionable whether these tiger beetles are of much importance in the field (*9*, *12*).

Adults of *Tetracha carolina* lived 35 days and of *T. virginica* 27 days in the insectary. The average quantity of food eaten per day during confinement is shown in table 6.

TABLE 6.—*Food eaten daily by adult Tetracha carolina and T. virginica confined in an insectary*

Species	Average hosts eaten per day						
	Eggs	First instar	Second instar	Third instar	Fourth instar	Pupa	Adults
	Number	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
Tetracha carolina	20.33	12.20	6.10	3.05	0.61	0.76	1.02
Tetracha virginica	25.34	15.22	7.61	3.81	.76	.95	1.27

HEMIPTERA

A small anthocorid bug, *Orius insidiosus*, observed by Jones in Ohio, was found feeding on probably 4 percent of the pupae late in June.

Two species of Nabidae, *Nabis ferus* and *N. roseipennis*, were observed feeding on eggs and young larvae of the bean beetle at Columbus, Ohio, in 1924, by D. M. DeLong.

The wheel bug, *Arilus cristatus*, consumed large numbers of bean beetles in confinement at Birmingham, Ala. One adult lived 88 days and drained the contents from 60 individual hosts, most of which

were pupae and adults. This bug consumed, on an average, 2.68 third-instar larvae, 0.54 fourth-instar larva, 0.67 pupa, and 0.89 adult per day.

The assassin bug *Sinea diadema* was observed feeding on larvae and pupae at Birmingham, Ala., and on adult bean beetles at Columbus, Ohio. It is not of much importance in the control of this insect.

Stiretrus anchorago (fig. 2) is the most efficient as well as the most numerous of the pentatomids attacking the bean beetle in Mexico and the southern part of the United States. This species occurs also throughout the Central, Middle Atlantic, and New England States, but is not numerous in these sections. Larvae of the bean beetle are more readily attacked in the field than are other stages of the host. In the insectary it was observed that the mortality among nymphs and adult bugs was greatest where only bean beetle eggs were supplied as food. The length of the developmental stages of this predator and the average number of hosts eaten per day in the insectary at Birmingham, Ala., are summarized in table 7.

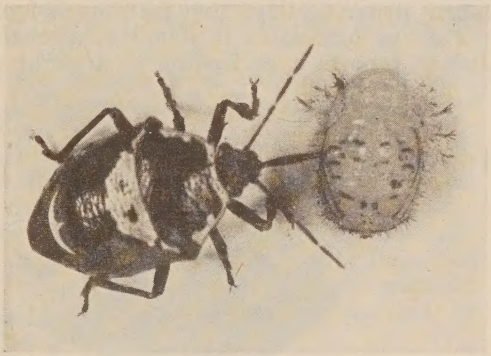

FIGURE 2.—*Stiretrus anchorago* feeding on a pupa of the Mexican bean beetle. ×4.

TABLE 7.—*Data on development and feeding of Stiretrus anchorago when given bean beetle eggs, larvae, and pupae for food*

Stage	Time in stage	Average hosts eaten per day					
		Eggs	First instar	Second instar	Third instar	Fourth instar	Pupa
	Days	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
Egg	7–8						
First-stage nymph	2–3						
Second-stage nymph	2–4	2.59	1.55	0.78	0.39	0.08	0.10
Third-stage nymph	3–5	2.92	1.75	.81	.44	.09	.11
Fourth-stage nymph	4–5	3.80	2.28	1.13	.57	.11	.14
Fifth-stage nymph	7	5.62	3.37	1.69	.84	.17	.21
Adult		16.67	10.00	5.00	2.50	.50	.63

Podisus maculiventris (fig. 3) is usually abundant in the area of bean beetle infestation east of the Mississippi River. Some investigators report it as preying upon all stages of the bean beetle while others limit its attacks to the larval and pupal stages. During the summers of 1934 and 1935 efforts to rear nymphs of *P. maculiventris* from the second instar (first carnivorous stage) on eggs of the bean beetle were unsuccessful. Large nymphs and adult bugs fed on bean beetle eggs to a slight extent. Last, or fifth-instar nymphs, reared in the laboratory, consumed one large fourth-instar larva or a pupa

a day for the first 4 to 6 days, but took little or no food for the 4 or more days preceding the molt to the adult stage.

A total of 23 nymphs of *Podisus maculiventris* were reared from egg to adult on larvae and pupae of the bean beetle at Columbus, Ohio, at a cabinet temperature of approximately 70° F. The average length of the developmental stages are as follows: Egg 5 days, first-instar nymph 3 days, second-instar 4 days, third-instar 4.1 days, fourth-instar 6.3 days, and fifth-instar nymph 10.7 days.

Perillus bioculatus is found occasionally in bean fields in Ohio. Jones [3] reports it as feeding to a slight extent on immature stages

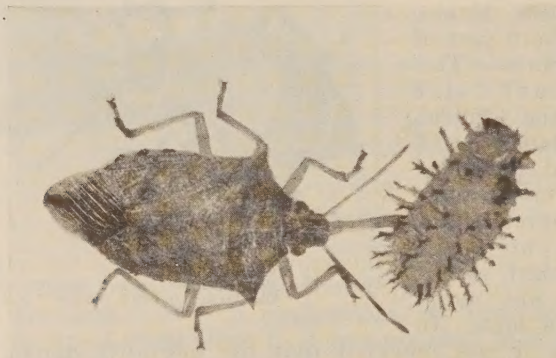

FIGURE 3.—The spined soldier bug (*Podisus maculiventris*) feeding on a larva of the Mexican bean beetle.

of the bean beetle. Efforts to rear *P. bioculatus* in the laboratory beginning with the second instar (first carnivorous stage) either on eggs or larvae of the bean beetle were unsuccessful. Unlike nymphs of *Podisus maculiventris*, nymphs of *Perillus bioculatus* fed when bean beetle eggs alone were supplied and occasionally molted into fourth-instar nymphs before dying. It appears probable that *P. bioculatus* is attracted to bean fields by the presence of insects other than the bean beetle.

Perillus circumcinctus killed and partly consumed adult bean beetles in cage tests conducted by Stehr and Farrell (*17*) at Athens, Ohio, in 1933.

Acrosternum hilaris and *Nezara viridula*, two pentatomids which have been considered generally to be plant feeders, have been observed feeding on stages of the bean beetle.

Acrosternum hilaris has been taken several times in Connecticut feeding on larvae and pupae (*8*). Four adults observed feeding on bean beetle eggs in the field at Birmingham, Ala., were confined in the insectary where each adult consumed approximately 15 bean beetle eggs per day. One adult lived for 25 days in the insectary.

Nezara viridula nymphs, in Ohio, have been observed puncturing most of the eggs of several masses near their base and withdrawing the contents (*15*).

[3] JONES, M. P. A TWO-YEARS' STUDY OF THE BIOLOGY AND CONTROL OF THE MEXICAN BEAN BEETLE (EPILACHNA CORRUPTA) IN OHIO. 1925. (Unpublished manuscript.)

Larvae and adults of lacewing flies, particularly *Chrysopa oculata* and *C. rufilabris* (*3*, *9*, *12*), have been observed feeding on the young larval instars and pupal stage of the bean beetle at Birmingham and elsewhere.

MISCELLANEOUS PREDATORS

A centipede was observed by Jones [4] feeding on an adult bean beetle in the spring of 1924. The beetle was still alive although the viscera had been eaten away. Several other beetles had been mutilated in the same manner.

A spider, *Allothrombium* sp., was observed feeding on the bean beetle at Norton, Va., by T. J. Tudor in 1927. The spiders appeared to be quite prevalent in the bean field.

A common garden toad, captured in a bean field, was observed by L. W. Brannon to consume larvae and adult bean beetles in the laboratory at Birmingham, Ala., in 1923.

Turkeys have been observed feeding on bean beetles in the field, according to Douglass (*4*). Quail and young pheasants that died for some unknown reason were opened and found to have consumed quantities of bean beetles.[5] Guinea fowl have been reported by farmers in Alabama to feed on adult beetles.

Skunk droppings, collected by H. C. Mason in a field of beans at South Point, Ohio, during the summer of 1935, contained several elytra of the bean beetle.

BACTERIA AND FUNGI

Unidentified species of *Coccobacillus* and *Streptococcus* [6] were present in samples of dead bean beetle larvae and pupae collected at Birmingham, Ala. (*12*). Not infrequently light- to dark-brown dead larvae and pupae were observed in the field attached to leaves.

What appeared to be a bacterial disease killed many first- and second-instar bean beetle larvae in South Carolina, according to Eddy (*6*), chiefly during August when the driest period occurred.

Beauveria globulifera [7] is capable of causing high mortality among hibernating bean beetles in the Estancia Valley, N. Mex., during favorable years (*5*). Douglass inoculated several series of beetles by smearing the fluid from dead beetles under the wings and by direct injection. He found that inoculated beetles died within a few days. The feces became brown and stringy, and later a brownish fluid exuded from the beetles.

Cephalothecium sp.,[8] regarded generally as a saprophytic fungus, was present in eggs of the bean beetle collected by Luther Brown at Thomasville, Ga., in 1921. Egg masses similar to those from which this fungus was obtained were conspicuous because of the presence of brown spots partly covering the eggs.

Cordyceps militaris [7] was found to be present in dead beetles taken from hibernation in New Mexico and Ohio.

Isaria sp.[7] was present in dead beetles taken from hibernation in New Mexico and Virginia.

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[4] See footnote 3.
[5] According to correspondence from A. C. Smith, State game protector of Schuylkill County, Pa., in 1929.
[6] Determined by G. F. White.
[7] Determined by Vera K. Charles, of the Division of Mycology and Disease Survey, Bureau of Plant Industry.
[8] Determined by A. T. Speare.

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